

ABSTRACT

Compositions, inks and methods for forming a patterned silicon-containing film and patterned structures including such a film. The composition generally includes (a) passivated semiconductor nanoparticles and (b) first and second cyclic Group IVA compounds in which the cyclic species predominantly contains Si and/or Ge atoms. The ink generally includes the composition and a solvent in which the composition is soluble. The method generally includes the steps of (1) printing the composition or ink on a substrate to form a pattern, and (2) curing the patterned composition or ink. In an alternative embodiment, the method includes the steps of (i) curing either a semiconductor nanoparticle composition or at least one cyclic Group IVA compound to form a thin film, (ii) coating the thin film with the other, and (iii) curing the coated thin film to form a semiconducting thin film. The semiconducting thin film includes a sintered mixture of semiconductor nanoparticles in hydrogenated, at least partially amorphous silicon and/or germanium. The thin film exhibits improved conductivity, density, adhesion and/or carrier mobility relative to an otherwise identical structure made by an identical process, but without either the semiconductor nanoparticles or the hydrogenated Group IVA element polymer. The present invention advantageously provides semiconducting thin film structures having qualities suitable for use in electronics applications, such as display devices or RF ID tags, while enabling high-throughput printing processes that form such thin films in seconds or minutes, rather than hours or days as with conventional photolithographic processes.